SURVEY REPORT

106-MILE SITE SEDIMENT TRAP PROGRAM MOORING DEPLOYMENT SURVEY MAY 1990

EPA Contract No. 68-C8-0105
Work Assignment 1-110

June 22, 1990

Submitted to

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Marine and Estuarine Protection
Washington, DC

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1.0 INTRODUCTION

As required by the Ocean Dumping Ban Act of 1988 (ODBA), a new 106-Mile Deepwater Municipal Sludge Site (106-Mile Site) Monitoring Plan (Battelle, 1990a) was developed jointly by the Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Coast Guard (USCG). This EPA - NOAA - USCG plan supersedes the monitoring plan (for the 106-Mile Site) developed and implemented by EPA (Battelle, 1988a,b). The new plan is being implemented to determine the transport and fate of municipal sludge dumped at the 106-Mile Site, whereas the original Monitoring Plan was directed toward (1) assessing of ocean dumping permit conditions and (2) determining whether the dumping of sludge in the ocean impacted living marine resources. The joint monitoring plan consists of four tiers that are similar to those described in the previous EPA Monitoring Plan (Battelle, 1988a,b). Tier 1 describes the monitoring of waste characteristics and disposal operations; Tier 2 focuses on the nearfield fate and short-term effects, whereas Tiers 3 and 4 address farfield fate and long-term effects, respectively.

The 106-Mile Site Sediment Trap Program was developed and is being implemented under the new monitoring plan. It is a key element in continuing Tier 3 monitoring activities at the site. The following six Tasks have been identified under the 106-Mile Site Sediment Trap Program; the first three have been completed.

- <u>Task 1</u> Development of a Field Plan (Battelle, 1990b) that describes the scope of the program, preliminary design of the subsurface moorings and sediment traps, the types of instrumentation to be deployed, and the rationale behind the placement of the moorings
- <u>Task 2</u> Equipment Preparation, including the final design of mooring arrays and sediment traps, fabrication of mooring arrays and sediment traps, and preparation of current meters and acoustic releases for deployment (Battelle, 1990c)
- <u>Task 3</u> Deployment Survey aboard the Fishing Vessel (F/V) *Delaware II*
- <u>Task 4</u> Recovery and redeployment of mooring arrays during a Fall 1990 survey
- <u>Task 5</u> Analysis of sediments collected and current meter data acquired during the initial deployment
- <u>Task 6</u> Recovery of all moorings and instrumentation.

Under Task 3, EPA conducted a 6-day survey aboard the F/V *Delaware II* to deploy 10 subsurface sediment trap/current meter moorings in the vicinity of the 106-Mile Site. The moorings were deployed in water depths ranging from 1500 to 2800 m. Eight of the 10 moorings were deployed less than 25 nmi from the 106-Mile Site. The other two moorings were deployed 60-100 nmi southwest of the 106-Mile Site. A map of the study area is shown in Figure 1.

Mobilization for the survey was conducted May 18 through May 20, 1990, at the NOAA Northeast Fisheries Center (NEFC) in Woods Hole, Massachusetts. The F/V *Delaware II* departed Woods Hole at 1545 h, May 21, 1990. Mooring deployment operations commenced at 0630 h, May 22, 1990, at Station J and were complete at 1300 h, May 25, 1990. The F/V *Delaware II* arrived back in Woods Hole at 0630 h, May 26, 1990. During the 6-day survey all 10 moorings were deployed successfully. The survey was performed by Battelle with significant subcontracted support from Science Applications International Corporation (SAIC), under the technical direction of the U.S. EPA (Contract No. 68-C8-0105). The participants are listed in Table 1.

This survey report discusses the May 21-26 deployment survey aboard the F/V *Delaware II*. The survey objectives and survey accomplishments are discussed in Sections 2 and 3, respectively. The equipment deployed during the survey and the deployment operation is summarized in Section 3 tables. Section 4 addresses problems encountered on the survey. A discussion of the recovery/turnaround survey (scheduled for Fall 1990) is presented in Section 5. A field log for the deployment survey is given in the Appendix.

2.0 SURVEY OBJECTIVES

The 106-Mile Site Sediment Trap Program is being conducted by EPA to help determine the fate and effects of sludge dumped at the 106-Mile Site. It specifically focuses on field observations of where sludge particles are transported after disposal at the 106-Mile Site.

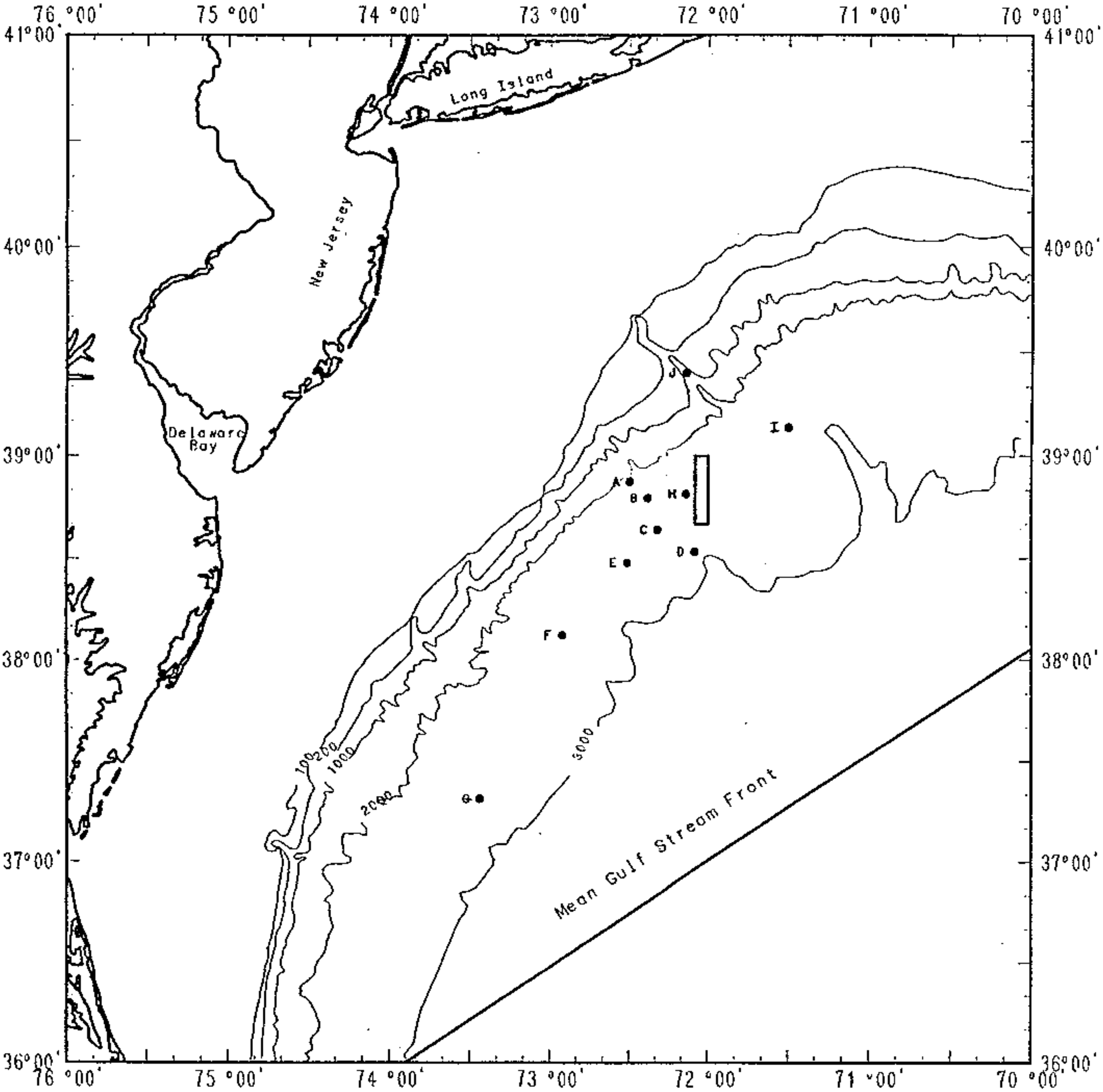


FIGURE 1. FINAL LOCATIONS FOR THE 106-MILE SITE SEDIMENT TRAP MOORINGS

TABLE 1. SURVEY PARTICIPANTS

Organization	Personnel	Task
EPA, Headquarters	David Redford	Chief Scientist
EPA, Region 2	Douglas Pabst	EPA Observer, Sampling
Battelle	Charles Willauer	Second Scientist, Task Leader
	Kevin King	Sediment Trap Engineer
	Debra West	Sediment Trap Chemist
	Anthony Luksas	Sediment Trap Technician
SAIC	Gerald Cook	Mooring Coordinator
	James Singer	Electronics Engineer
	Frank Wyatt	Mooring Specialist
	Gary Davis	Navigator

TABLE 2. DATE, TIME, POSITION, AND DEPLOYMENT DEPTH OF EACH MOORING DEPLOYED DURING THE 106-MILE SITE SEDIMENT TRAP SURVEY

Mooring Designation	Date of Deployment	Deployment[a] Time (EDT)	Anchor Drop Position	Final Anchor Position	Loran-C[b]	Depth[c] (m)
A	25-V-90	0706	38°52'39."501N 72°29'50."583W	38°52'30."218N 72°29'48."826W	15118.65 26232.27 42757.00	1978
B	23-V-90	2305	38°47'41."196N 72°22'53."412W	No acoustic range data	15090.10 26191.36 42713.59	2433
C	23-V-90	1615	38°38'28."837N 72°19'05."605W	38°38'25."356N 72°19'16."205W	15081.15 26171.68 42631.26	2644
D	23-V-90	0828	38°32'08."821N 72°04'48."367W	38°32'00."157N 72°05'05.902W	15020.90 26094.16 42581.70	2784
E	25-V-90	0123	38°28'47."343N 72°30'48."766W	No Acoustic Range Data	15144.37 26240.30 42535.90	2711
F	24-V-90	2010	38°07'29."330N 72°55'14."668W	No Acoustic Range Data	15267.59 26373.99 42316.66	2600
G	24-V-90	1208	37°18'55."586N 73°26'15.745W	37°18'42."935N 73°26'12."651W	15409.71 26514.89 41810.21	2610
H	25-V-90	1309	38°48'53."823N 72°08'16."866W	No Acoustic Range Data	15018.80 26105.12 42729.54	2606
I	22-V-90	2127	39°08'09."224N 71°29'57."190W	39°08'06."327N 71°30'06."262W	14805.79 25865.98 42903.98	2600
J	22-V-90	1106	39°24'03."554N 72°08'12.079W	39°24'00."574N 72°08'07."195W	14973.09 26089.25 43042.36	1500

[a] Greenwich Mean Time = Eastern Daylight Time + 4 h.
[b] All Loran-C time differences are anchor position.
[c] All depths are as indicated on fathometer at time of anchor drop (corrections not applied). Transducer draft: ~10 m. Estimated sound speed correction: ~-20 m.

TABLE 3. MOORING INSTRUMENTATION

Mooring	Instrument	Serial No.	Depth (m)
A	Sed. Trap[a]	35	65
	ACM 2[b]	1165	67
	RCM[c]	5219	165
	GO[d]		465
	Sed. Trap	25	953
	Sed. Trap	43	966
	RCM	2830	968
	Sed. Trap	10	1710
	Sed. Trap	21	1720
	Sed. Trap	27	1730
	RCM	2919	1732
	Benthos Rel.[e]	568	1949
	Benthos Rel.	569	1949
B	Sed. Trap	4	98
	Sed. Trap	48	991
	Sed. Trap	52	1003
	Sed. Trap	14	2161
	Sed. Trap	44	2173
	Sed. Trap	39	2186
	EG&G Rel.[f]	303	2398
C	Sed. Trap	15	119
	ACM 2	1162	120
	ACM 2	1163	168
	ACM 2	1164	216
	RCM	7507	512
	Sed. Trap	58	1001
	Sed. Trap	23	1014
	RCM	6892	1013
	RCM	2919	1751
	Sed. Trap	11	2359
	Sed. Trap	56	2372
	Sed. Trap	7	2384
	Benthos Rel.	566	2596
	Benthos Rel.	567	2596

TABLE 3. MOORING INSTRUMENTATION (Continued)

Mooring	Instrument	Serial No.	Depth (m)
D	Sed. Trap	34	98
	ACM 2	1160	100
	Sed. Trap	9	992
	Sed. Trap	12	1004
	RCM	5004	1006
	Sed. Trap	3	2533
	Sed. Trap	46	2545
	Sed. Trap	31	2558
	Benthos Rel.	007	2759
	Renthos Rel.	572	2759
E	Sed. Trap	32	88
	Sed. Trap	6	989
	Sed. Trap	26	1001
	Sed. Trap	5	2439
	Sed. Trap	30	2451
	Sed. Trap	19	2464
	EG&G Rel.	204203	2677
F	Sed. Trap	17	92
	ACM 2	1269	94
	Sed. Trap	54	985
	Sed. Trap	24	997
	RCM	7595	997
	Sed. Trap	13	2326
	Sed. Trap	22	2339
	Sed. Trap	20	2351
	Benthos Rel.	520	2564
	Benthos Rel.	573	2564
G	Sed. Trap	28	103
	ACM 2	1246	105
	Sed. Trap	49	998
	Sed. Trap	2	1011
	Sed. Trap	57	2337
	Sed. Trap	37	2349
	Sed. Trap	16	2362
	Benthos Rel.	565	2575

TABLE 3. MOORING INSTRUMENTATION (Continued)

Mooring	Instrument	Serial No.	Depth (m)
H	Sed. Trap	33	105
	Sed. Trap	29	995
	Sed. Trap	36	1007
	Sed. Trap	50	2333
	Sed. Trap	1	2346
	Sed. Trap	41	2358
	EG&G Rel.	601031	2571
I	Sed. Trap	38	106
	Sed. Trap	55	998
	Sed. Trap	8	1010
	Sed. Trap	18	2338
	Sed. Trap	47	2350
	Sed. Trap	42	2363
	Benthos Rel.	570	2576
J	Sed. Trap	40	93
	Sed. Trap	51	986
	Sed. Trap	45	999
	Benthos Rel.	571	1471

[a] Sed. Trap: Battelle Sediment Trap
[b] ACM 2: EG&G (Neil Brown) Acoustic Current Meter, Model ACM 2
[c] RCM: Aanderaa Recording Current Meter
[d] GO: General Oceanics Winged Current Meter
[e] Benthos Rel: Benthos Acoustic Release - Model 865A
[f] EG&G Rel: EG&G Acoustic Release

The moorings were deployed in the following order: J, I, D, C, B, G, F, E, A, and H. The initial deployment schedule, originally proposed in the survey plan (Battelle, 1990d), was changed to fully utilize daylight hours. These changes occurred because (1) the departure time was delayed 6 hours owing to mobilization issues and (2) some delays were encountered in determining the correct location to deploy the moorings.

3.2 QUALITATIVE DISCUSSION OF ACCOMPLISHMENTS

The F/V *Delaware II* was an effective working platform for the deployment operation. Ample deck space made storage of wire rope, subsurface buoys, and mooring hardware possible without consuming working space on deck.

Each mooring, made up of wire and Kevlar mooring segments, was spooled onto one of two large trawl winches prior to deployment. An example of a typical mooring is shown in Figure 2. The mooring was then payed out as the ship steamed into the wind and current. Both winches proved to be effective for this type of deployment operation. The especially long working deck aboard the F/V *Delaware II* made deployment of the sediment trap arrays (2-3 sediment traps) possible without having to stop each time to connect and disconnect mooring segments. The sediment traps were deployed smoothly over the stern mooring deck. Plastic bags that covered the tops of the sediment traps to prevent contamination were removed just prior to deployment. No visual indication of contamination was observed during deployment operations.

All current meters and acoustic releases underwent predeployment checkouts onboard the F/V *Delaware II*. All but one instrument, a Government-furnished RCM-5 current meter, passed the checkout procedure. A spare General Oceanics current meter was deployed in place of the malfunctioning RCM-5 current meter. All current meters were deployed over the stern mooring deck without incident.

Excellent weather conditions prevailed throughout most of the deployment survey. Wave heights were greatest (3-4 m at EPA's 106-Mile Site Real-Time Buoy) on the first day of the survey, but did not delay deployment operations.

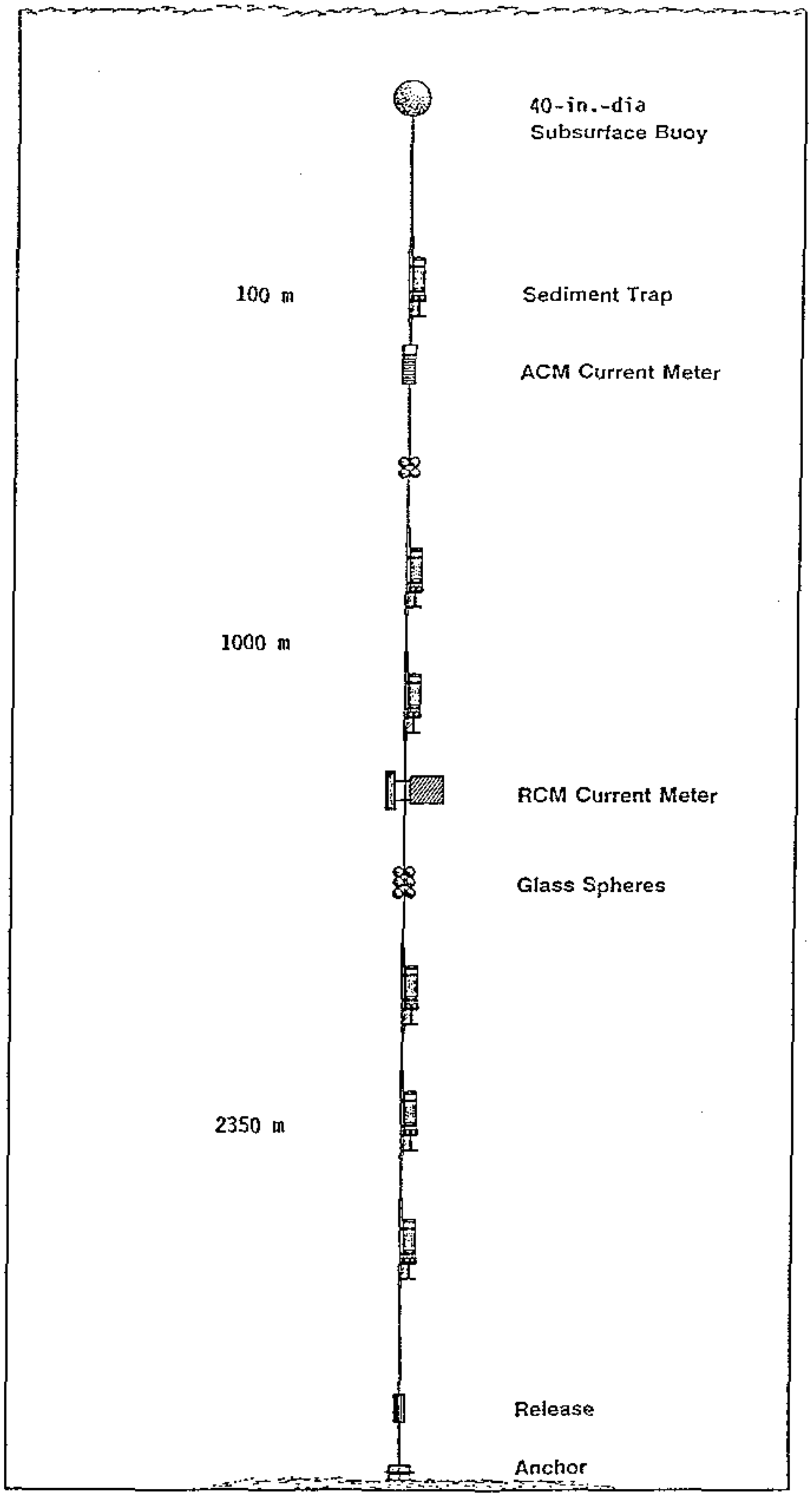


FIGURE 2. MAJOR COMPONENTS OF MOORING C

4.0 PROBLEMS ENCOUNTERED

The National Ocean Survey charts used during the planning phase of the program to determine the depths at the mooring locations were not sufficiently accurate. This discrepancy presented a problem since the moorings had been designed for specific depths, and their overall lengths could not be easily altered. Upon arrival at each predetermined mooring position, the water depth was determined by using a Raytheon Model DSF-6000 fathometer. A decision to steam NW or SE, perpendicular to the isobaths, was made based on the depth of the water at the initial position. For example, if the water depth was 50 m greater than the design depth, then the ship would steam toward a position thought to be in more shallow water (generally to the NW) until the design depth was met. The mooring was then deployed at this new position.

A more accurate determination of mooring depths prior to the survey would have minimized the delays entailed in the searches for the correct depths, sometimes found 2 to 6 nmi from the predetermined mooring position. Although the final mooring positions are different from the proposed positions, the spatial orientation of the moored arrays is essentially unchanged and therefore, the initial program objectives have not been jeopardized. Mooring segments made up of chain, wire rope, and Kevlar line were added to moorings B, C, and E, which could not be moved from the predetermined positions without jeopardizing the scientific program objectives.

5.0 DISCUSSION OF RECOVERY/DEPLOYMENT OPERATION

A brief section describing the proposed current meter/sediment trap mooring recovery is presented so that preparations for the recovery survey during fall 1990 can begin. Final details of the mooring recovery procedure will be worked out with NOAA personnel once the F/V *Delaware II* returns from a 60-day yard period June through July 1990.

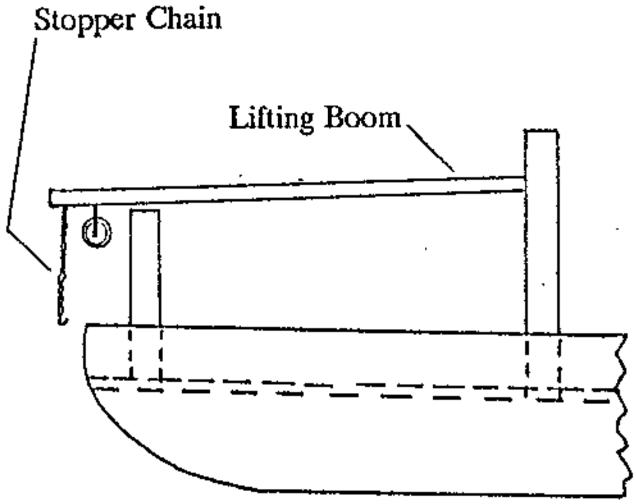
5.1 SHIP PREPARATIONS FOR RECOVERY/REDEPLOYMENT OPERATION

The principal objectives of sediment trap/current meter mooring recovery are to (1) keep the sediment traps vertically inclined, (2) prevent contaminating material from entering the top of the sediment trap as the moorings are recovered aboard the F/V *Delaware II,* and (3) prevent physical damage to the current meters and acoustic releases during recovery. With these objectives in mind, mooring recovery operations over the stern of the vessel are recommended for the following reasons:

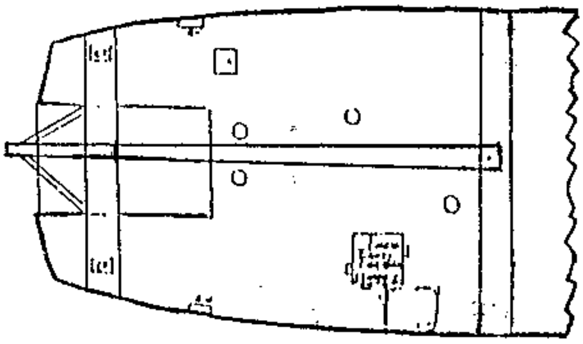
- The chance of inclining the sediment trap is minimized when recovery is made over the stern as opposed to over the side of the ship. The lateral drift of the ship (and, hence, that of the vertically inclined mooring) can be more easily controlled by heading the ship into the wind or the current.
- The sediment traps are less likely to come in contact with the ship's hull (and risk contamination) when they are recovered over the stern as opposed to over the side of the ship.
- The ship's ability to maneuver is inherently better when oceanographic gear is streamed astern as opposed to off the side of the ship, where the risk of fouling the ship's propellers is present.
- Ample deck space is provided both for the survey equipment and the safety of the deck crew.
- The ship is outfitted with a crane to handle buoys and sediment traps too heavy to handle by hand.
- There is greater clearance at the stern of the ship to hoist instruments, subsurface buoys, and glass spheres.

In the event of a steering casualty, there is little chance of the stern passing over the wire. The ship will most likely have to tow the mooring slowly ahead to keep it streamed astern and prevent the glass spheres from tangling in the wire. It is a relatively easy task to keep the vessel heading into the wind/waves/current and thereby maintain adequate control during the recovery operation.

<u>Arrangement of deck equipment</u>: Both trawl winches will be utilized during the recovery operation. A 0.75-in. leader line with a snap hook spliced to the end of the line will be attached to each trawl winch wire. A large block will be installed at the end of the ship's lifting boom. The boom will be secure in its cradle. The block must be wide enough to allow all shackles and slinglinks to pass between the cheeks. A length of 0.37-in. chain with a snap hook on the end will act as a stopper and will hang next to the block. The hook will hang freely about 2 ft above deck level. This arrangement is illustrated in Figure 3.



(a) Side view



(b) Plan view

FIGURE 3. SIDE VIEW (a) OF LIFTING BOOM, TRAWL/BLOCK, AND STOPPER CHAIN AND PLAN VIEW (b) DECK ABOARD F/V *DELAWARE II*

5.2 MOORING RECOVERY FOLLOWING ANCHOR RELEASE

The acoustic release will be fired from a distance of about one-third of the water depth from the estimated mooring position to avoid the possibility of the mooring striking the vessel as it surfaces [Figure 4(a)]. Before firing the release, a series of acoustic checks is run on the release to ensure that it is responding properly. Upon completion of the checks, the release is fired.

After the mooring has surfaced and all mooring floatation elements are visible [Figure 4(b)], the vessel will be maneuvered to the subsurface float in a manner that will not cause the mooring to foul. Each mooring string will have to be recovered from the top end to keep the sediment traps upright.

The following is the general recovery procedure.

> The snap hook on the end of the 0.75-in. leader line will be passed through the large trawl block and attached to a 12-ft pole. The pole will be used to maneuver the snap hook into the pickup loop on top of the 40-in. subsurface floats. As tension is taken on the trawl winch, the leader line will tighten and begin to lift the float from its attachment point. Once the subsurface buoy is attached, the ship will head into the wind/waves/current, maintaining only *minimum* tension on the mooring to keep the remaining floatation elements separated [Figure 4(c)].
>
> As an instrument or cluster of glass spheres reaches the block (Figure 5), the stopper hook will be snapped into the sling link below the mooring component [Figure 5(b)]. The winch will then be slacked off until tension is taken on the stopper [Figure 5(c)]. The instrument can then be unshackled from both the upper and lower mooring segments and removed [Figure 5(d)]. The leader line attached to the trawl winch is then reconnected to the mooring wire [Figure 5(e)], and the recovery will resume [Figure 5(f) and (g)].
>
> This procedure of passing tension around the instruments and glass spheres via stopper chains will continue until the acoustic release is on board, thereby completing the mooring recovery.

The hydraulic crane will be used to lift the sediment traps from the mooring deck to a point farther forward where the contained water can be filtered and the sediment sample removed. The estimated total weight of one sediment trap full of water is 220 lb.

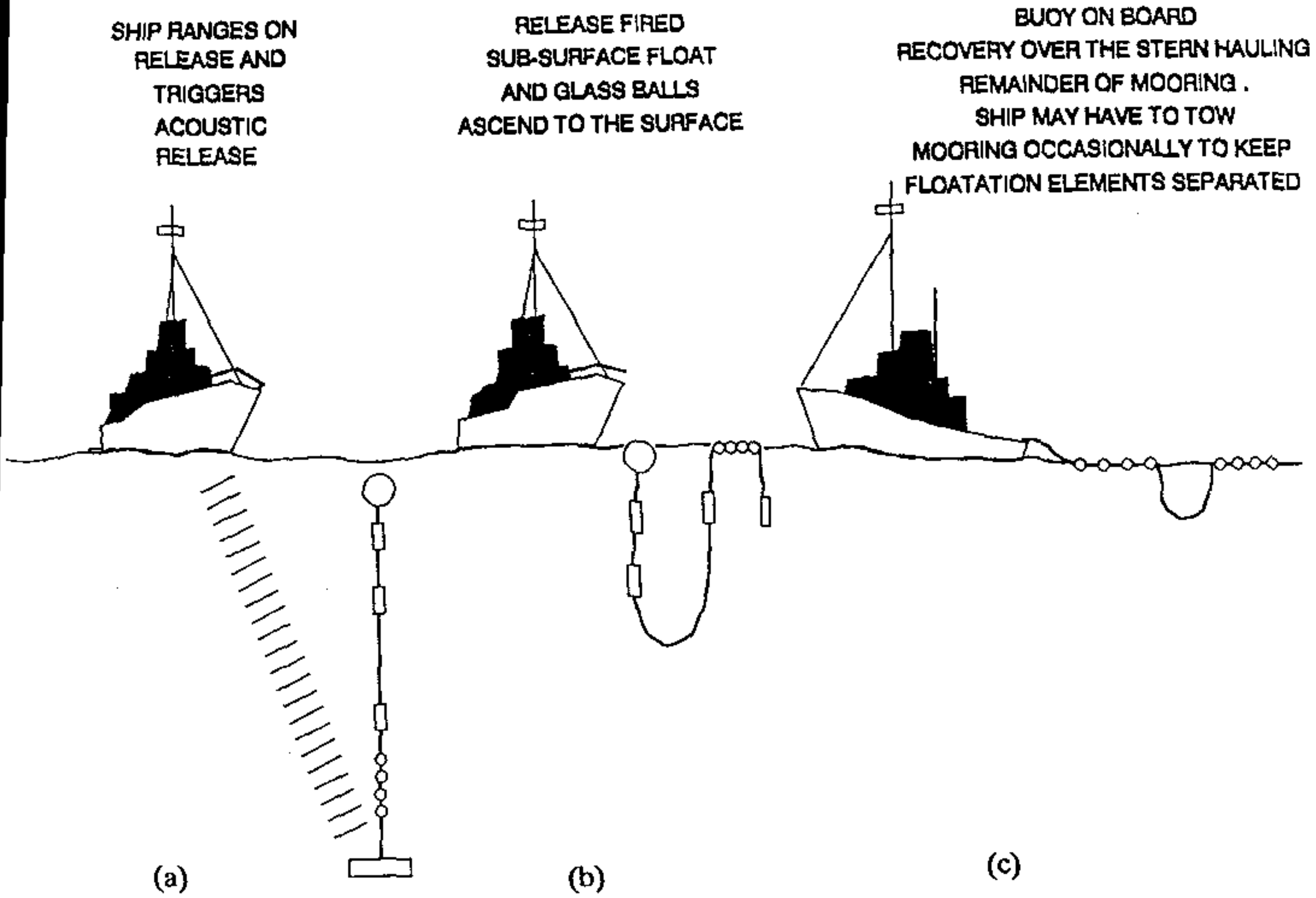


FIGURE 4. MOORING RECOVERY PROCEDURE. (a) INTERROGATION OF ACOUSTIC RELEASE. (b) SHIP MANEUVERING ALONGSIDE FLOATING MOORING. (c) SHIP TOWING SUBSURFACE MOORING

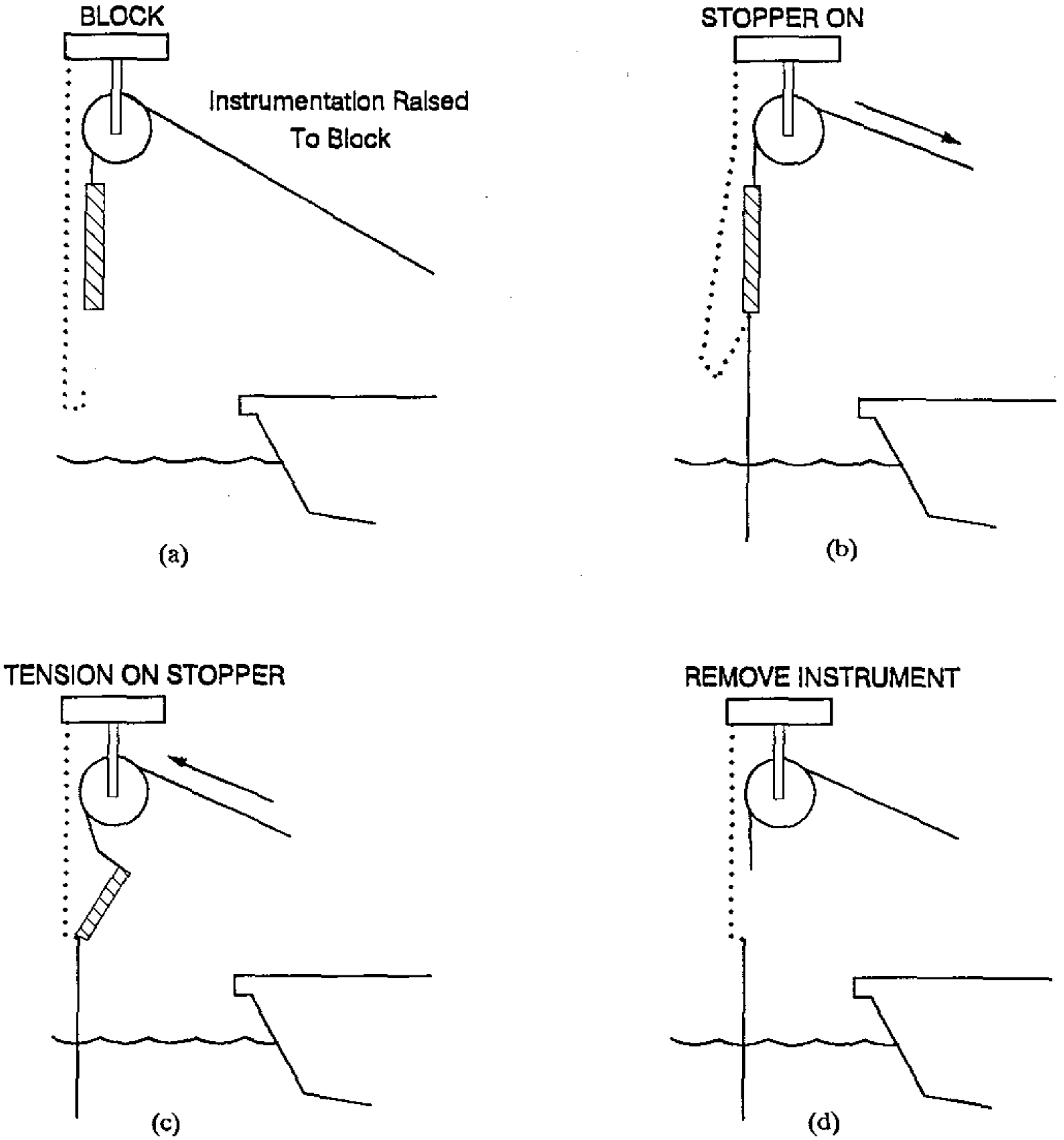


FIGURE 5. RECOVERY - REMOVAL OF INSTRUMENTS

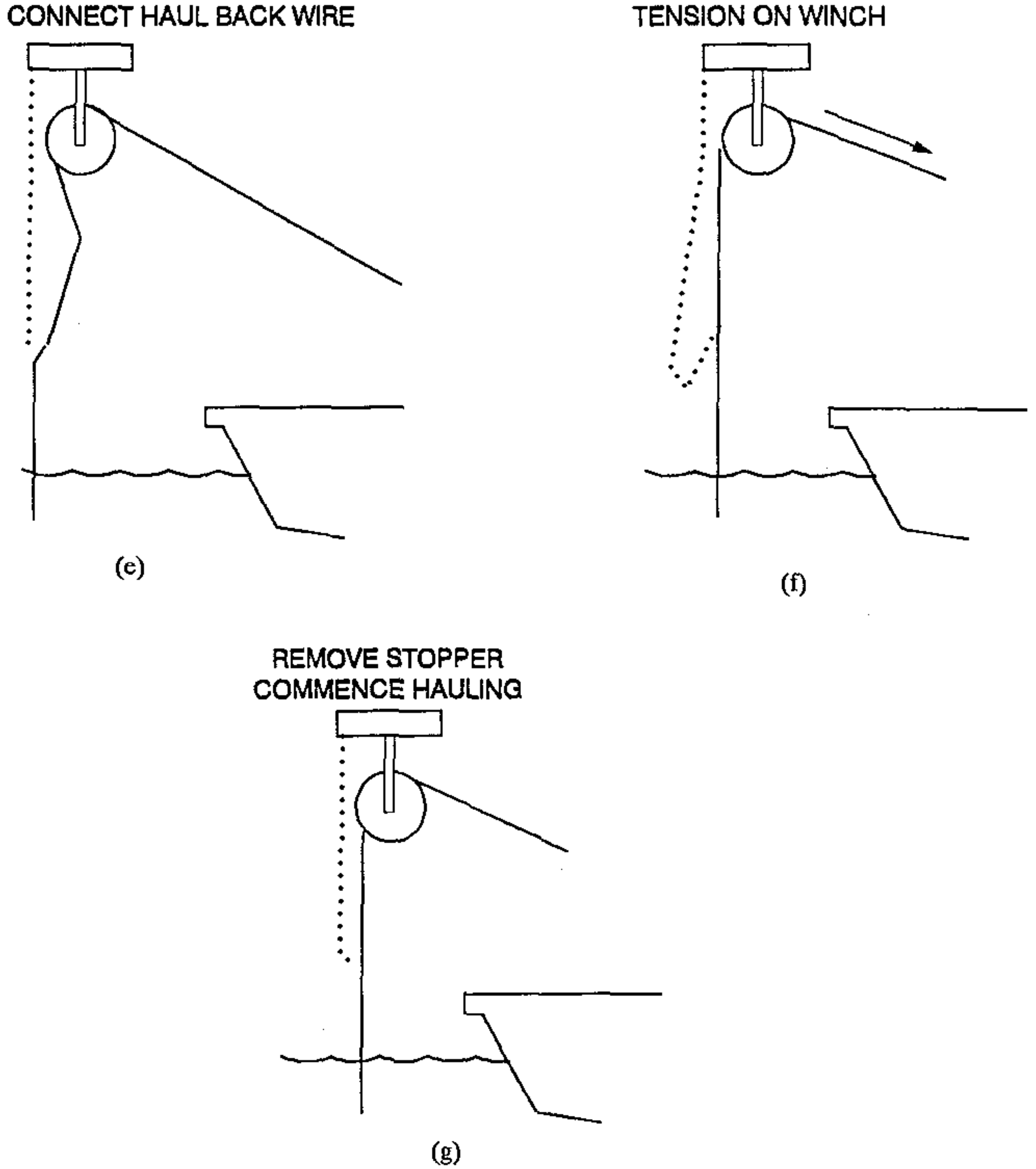


FIGURE 5. RECOVERY - REMOVAL OF INSTRUMENTS (Continued)

5.3 GENERAL POSTRECOVERY PROCEDURES

All current meters and acoustic releases will be washed down with fresh water on deck after recovery and prepared for redeployment. Any damage or corrosion will be noted and recorded.

The mooring wire will be reloaded and changed end-for-end to be ready for an anchor-last redeployment. During this operation, the wire and Kevlar will be inspected for damaged sections. The damaged sections will be replaced at this time.

Replacement Kevlar sections will be cut and spliced at sea. Replacement sections of wire will be cut and terminated prior to the survey. Complete replacement wire for moorings A and C are recommended, in addition to standard lengths of wire equivalent to 20% of each mooring.

Procedures governing the recovery/redeployment of current meters and sediment traps and the handling of the data during the recovery/redeployment survey are given in the Quality Assurance Project Plan (Battelle, 1990c).

6.0 REFERENCES

Battelle. 1990a. Draft of the 106-Mile Deepwater Municipal Sludge Site Monitoring, Research, and Surveillance Plan. A report submitted to the U.S. Environmental Protection Agency under Contract No. 68-C8-0105. Work Assignment 1-14.

Battelle. 1990b. Field Plan for the Sediment Trap Program of the 106-Mile Site Monitoring Program. A report submitted to the U.S. Environmental Protection Agency under Contract No. 68-C8-0105. Work Assignment 1-110.

Battelle. 1990c. Quality Assurance Project Plan for the Sediment Trap Program of the 106-Mile Site Program. A report submitted to the U.S. Environmental Protection Agency under Contract No. 68-C8-0105. Work Assignment 1-110.

Battelle. 1988a. Final Draft Monitoring Plan for the 106-Mile Deepwater Municipal Sludge Site. A report submitted to the U.S. Environmental Protection Agency under Contract No. 68-03-3319. Work Assignment 1-22.

Battelle. 1988b. Implementation Plan for the 106-Mile Deepwater Site Monitoring Program. A report submitted to the U.S. Environmental Protection Agency under Contract No. 68-03-3319. Work Assignment 1-22.

Appendix

CRUISE LOG

CRUISE DE90-07
F/V *DELAWARE II* CRUISE
21-26 May 1990

Monday, May 21	1545	Depart Woods Hole.
	1615	Begin saftey briefing with Chief Mate.
	2030	Spooling Mooring J onto trawl winch.
Tuesday, May 22	0630	Arrive Mooring J area; begin bathymetric survey.
	0929	Begin deploying Mooring J.
	1106	Mooring J deployed; begin ranging.
	1145	Rangings completed; under way for Mooring I area.
	~1530	Arrive Mooring I area; begin bathymetric survey.
	1955	Begin deploying Mooring I.
	2127	Mooring deployed; begin ranging.
	2230	Rangings completed; under way for Mooring D area.
Wednesday, May 23	0245	Arrive Mooring D area; begin bathymetric survey.
	0524	Begin deploying Mooring D.
	0828	Mooring D deployed; begin ranging.
	0935	Rangings completed; under way for Mooring C area. Will proceed to a point 2 nmi south of design position to check depth.
	1042	Arrive Mooring C area; begin bathymetric survey.
	1239	Begin deploying Mooring C.
	1615	Mooring C deployed; begin ranging.
	1740	Rangings completed; under way for Mooring B area.
	1800	High-seas weather forecast reports good weather through Saturday.

Wednesday, May 23 (continued)	1825	Arrive Mooring B area; begin bathymetric survey.
	2110	Begin deploying Mooring B.
	2305	Mooring B deployed; begin ranging.
	2340	Rangings completed; under way for Mooring G area. (unable to contact release)
Thursday, May 24	0905	Arrive Mooring G area; begin bathymetric survey.
	1024	Begin deploying Mooring G.
	1208	Mooring G deployed; begin ranging.
	1315	Rangings completed; under way for Mooring F area.
	1820	Arrive Mooring F area; begin bathymetric survey.
	1851	Begin deploying Mooring F.
	2010	Mooring F deployed; under way for Mooring E area.
	2300	Arrive Mooring E area; begin bathymetric survey.
	2354	Begin deploying Mooring E.
Friday, May 25	0123	Mooring E deployed; under way for Mooring A area.
	~0400	Arrive Mooring A area; begin bathymetric survey.
	0534	Begin deploying Mooring A.
	0706	Mooring A deployed; begin ranging.
	0835	Rangings completed; under way for Mooring H area.
	1020	Arrive Mooring H area; begin bathymetric survey; observe 106-Mile Site Real-Time Buoy.
	1142	Begin deploying Mooring H.
	1309	Mooring H deployed; under way for Woods Hole.
Saturday, May 26	0630	Arrive Woods Hole; ship unloaded.
	0800	Scientific personnel depart.